DIRECT DRIVE HYBRID ROTARY MOTOR

[0001] The present invention relates generally to an electro-mechanically controlled, electro-magnetic conversion type of rotary motor.

STATEMENT OF GOVERNMENT INTEREST

[0002] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefore.

BACKGROUND OF THE INVENTION

[0003] Electromagnetic drive motors with operational phase controls are generally known in the art as disclosed for example in U.S. Patent No. 5,602,434 to Riedl, involving use of electromagnetic actuator rods engageable with a rotor under phase control to induce rotation thereof.

[0004] An important object of the present invention is to provide an electrically powered motor having plural components matched to the output torque load being applied in a mechanical impedance manner for enhancing electro-motive energy conversion.

SUMMARY OF THE INVENTION

[0005] Pursuant to the present invention, an electric motor has an output shaft with generally circular peripherally indented discs of different diameters mounted thereon. Torque is applied to the output shaft by engagement of the discs with push rods projecting from electromagnetic actuators positioned in angular spaced relation to each other about the output shaft on rail supports anchored to a rheological brake unit through which the output shaft extends. Under control applied through magnetic fields to rheological fluid within the brake unit, braking effect is removed from the disc plates during a free-wheeling operational phase. Electrical energy is also applied to the actuators for mechanically imparting torque to the output shaft through the push-rods engaging one of the peripheral indented disc plates selected under stroke control.

BRIEF DESCRIPTION OF THE DRAWING

[0006] A more complete appreciation of the invention and many of its attendant advantages will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

[0007] FIG. 1 is a side elevation view of a rotary drive motor constructed in accordance with one embodiment of the present invention;

[0008] FIG. 2 is a front elevation view of the rotary drive motor illustrated in FIG. 1;

[0009] FIG. 3 is a partial side section view taken substantially through a plane indicated by section line 3-3 in FIG. 1; and

[0010] FIG. 4 is an operational diagram of a rotary motor drive system corresponding to that associated with the rotary drive motor illustrated in FIGS. 1, 2 and 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0011] Referring now to the drawing in detail, FIG. 1 illustrates a rotary drive motor 10 having an axially elongated output shaft 12 with a small diameter end 14 and an opposite larger diameter base end 16. According to the embodiment shown in FIG. 1, a clutch-brake unit 18 is positioned on an end section 20 of the shaft 12 adjacent the base end 16, in abutment with a thrust bearing component 22. A torque drive imparting assembly generally referred to by reference numeral 24 is positioned on the shaft 12 between the unit 18 and a small diameter shaft end section 26 at the axial shaft end 14.

[0012] As shown in FIG. 2, the torque drive imparting assembly 24 includes four actuator units 28 positioned in 90° angular relation to each other about the shaft 12. Each of such actuator units 28 includes a pair of cylindrical actuator devices 30 held in close parallel spaced relation to each other within a support 32. Each of the actuator supports 32 as shown in FIGS. 1 and 2 is adjustably positioned within an elongated rail 34 at an outer end 36 opposite an inner end 38 anchored to the unit 18. Each rail 34 accordingly extends in angular relation to the axis 40 of the shaft 12 radially spaced therefrom by an increasing amount from the anchored rail ends 38 to the opposite rail ends 36 at which the actuator devices 30 are positioned in alignment with a large diameter force transfer wave plate 42 splined to the shaft end section 26 and having an indented periphery 44. Projecting from each of the cylindrical actuator devices 30 is a driving push rod 46, for engagement with the indented periphery 44 of the waveplate 42 so a to impart a torque force to the shaft 12 through the waveplate 42.

[0013] As shown in FIGS. 1 and 3, also positioned on and splined to the small diameter end section 26 of the shaft 12 is a smaller diameter force transfer disc wave plate 48. Each of the actuator units 28 may accordingly be displaced on its support 32 from the end 36 of its rail 34 as

shown in FIG. 3 to a position in alignment with the smaller diameter waveplate 48 so as to effect a change in stroke of the drive forces applied to shaft 12 by the actuator driven push rods 46 through the radially smaller waveplate 48, as compared to the drive stroke transferred to the shaft 12 through the larger diameter waveplate 42. Such repositioning of the actuator units 28 on the rails 34 is effected by positioning adjustment devices 50 respectively mounted on each of the rails 34 and connected to the actuator unit supports 32.

[0014] With continued reference to FIG. 3, the unit 18 is shown positioned on an intermediate larger diameter hollowed section 52 of the shaft 12 extending between the shaft end sections 20 and 26. The unit 18 includes an outer cylindrical housing 54 positioned on the section 52 in abutment with the thrust bearing component 22 at one axial end opposite its other axial housing end plate 56. The ends 38 of the rails 34 are anchored to the housing end plate 56. The housing 54 is fixedly anchored in position on the shaft section 52 for rotational support of the shaft 12 on its axis 40 about which the shaft 12 is rotated relative to the housing 54 about its axis 40. Enclosed within the housing 54 are chambers 58 filled with a magneto-reheological fluid in surrounding relation to the shaft section 52 which is peripherally formed with splines 60 through which a pair discs 62 within the chambers 58 are positioned rotationally fixed to the shaft 12 by the shaft section 52. An electromagnetic coil 64 is also positioned within the housing 54 overlying a pair of permanent magnets 55, to partially or fully negate the braking effect thereby applied to the shaft 12 by the magnetic fields of the magnets 55 for free wheeling purposes. The magneto-rheological fluid filing the chamber 58 within such magnetic fields provides variable braking resistance to rotation of the shaft 12 through the discs 62.

[0015] As diagrammed in FIG. 4, an electrical power source 64 supplies electrical energy through timing phase control 66 to the four pairs of actuator devices 30 associated with the drive

torque imparting assembly 24 from which the generated drive forces are transferred through the waveplate 42 or 48 as torque applied to the output shaft 12. The electrical energy from the source 64 is also supplied through control 66 to the positioning devices 50 for adjustable displacement of the drive torque imparting assembly 24 between its positions respectively aligned with the waveplates 42 and 48 for stroke change purposes. Finally, through the free-wheel control 68, electrical energy from the source 64 is applied to coil 62 in the unit 18 during power-off phase of operation with respect to drive of the output shaft 12 by the actuators 30, for free-wheeling purposes.

[0016] Obviously, other modifications and variations of the present invention may be possible in light of the foregoing teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is: